



Antenna radiation patterns of module STM32WBA5MMG

Introduction

This technical note presents the results of radiated emission tests of the STM32WBA5MMG device made with the B-WBA5M-WPAN Connectivity Expansion Board.

It gives a detailed description of the equipment used, the test setup, and the results. The purpose is to demonstrate the capabilities of the STM32WBA5MMG module.

1 General information

This document applies to STM32 Arm®-based general-purpose microcontrollers or microprocessors.

Note: Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.



2 Description of the test

2.1 Description of the device under test

The table below provides the characteristics of the device under test (DUT).

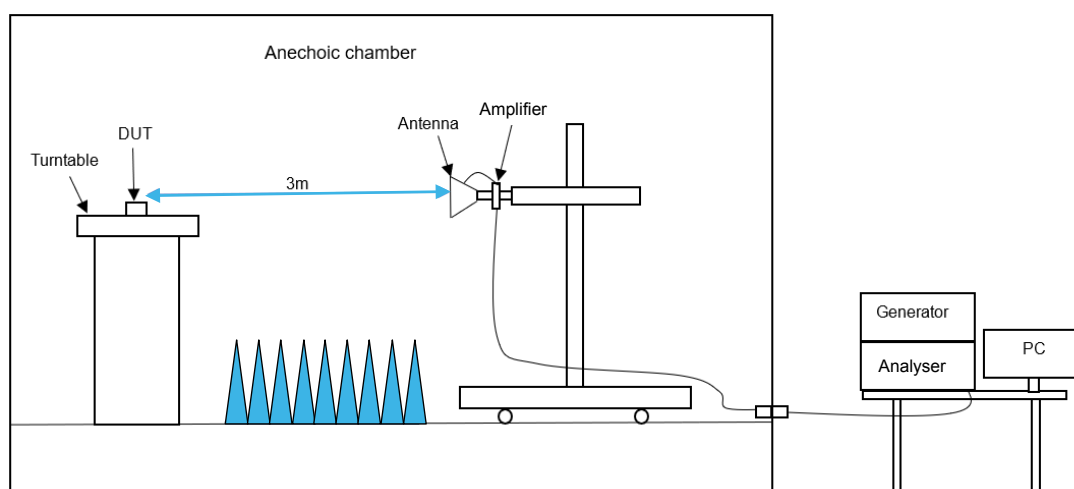
Table 1. Description of the DUT

Item	Description
Product	B-WBA5M-WPAN
Product identification	BWB5MWPAN1\$CZ3
Power supply	5 V USB
Running mode	Transmission of Bluetooth® Low Energy carrier frequency on low, middle, and high frequency channels
Test program	STM32CubeMonitor-RF
Description of the module features	- Frequency band: 2400 to 2483.5 MHz (Tx and Rx, wideband data transmission systems) - Bluetooth® Low Energy power setting: power is set at 10 dBm - Duty cycle: none - Modulation: none, CW configuration - Antenna type: integrated in module - Powered by 5 V dc from USB power supply - Equipment intended for use as a mobile device - Equipment designed for continuous operation
Dimensions of the PCB	56 × 22 × 1.6 mm

2.2 Test setup for radiated emissions

The following figures present the anechoic chamber setup diagram, and a picture of the setup mounted on STMicroelectronics laboratory to perform the test.

Figure 1. Anechoic chamber setup



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Figure 2. Anechoic chamber picture



2.3 Test equipment used for radiated emissions

The following table describes the test equipment used to perform the tests.

Table 2. Test equipment used for radiate emission

Description	Manufacturer	Model	Identifier
Horn antenna	SCHWARZBERCK	BBHA 9120D	EMC_002
RF cable	-	-	Cable antenna
RF cable	-	-	Cable_FilterAmpli_2
Semianechoic room	COMTEST	1766-1221 Ma	-
Antenna mast	Innco- Systems	MA2000-XP-ET	-
Turntable	Innco- Systems	-	MISC_0012A
Controller	Innco- Systems	CO3000	MISC_0012
Spectrum analyzer	Rohde&Schwarz	FSV3030	SPAN_0049
Preamplifier	SCHWARZBERCK	BBV 9718C 1-18 GHz	EMC_001
Radiated TEST BENCH SUITE	STMicroelectronics	-	-

3 Board positions and antenna polarization

3.1 Board positions

The board was tested in three different positions (X, Y, and Z). These setups are depicted in the following figures.

Figure 3. X board position

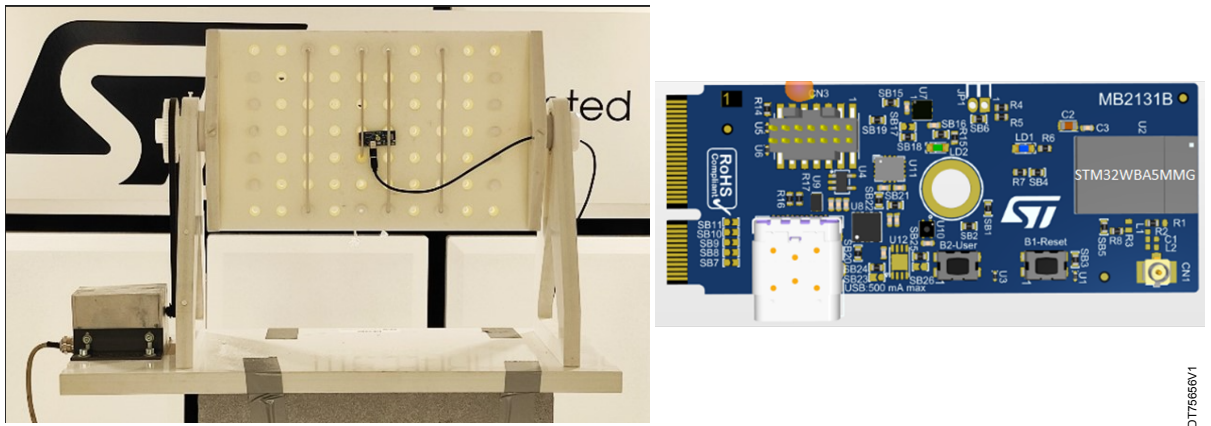


Figure 4. Y board position

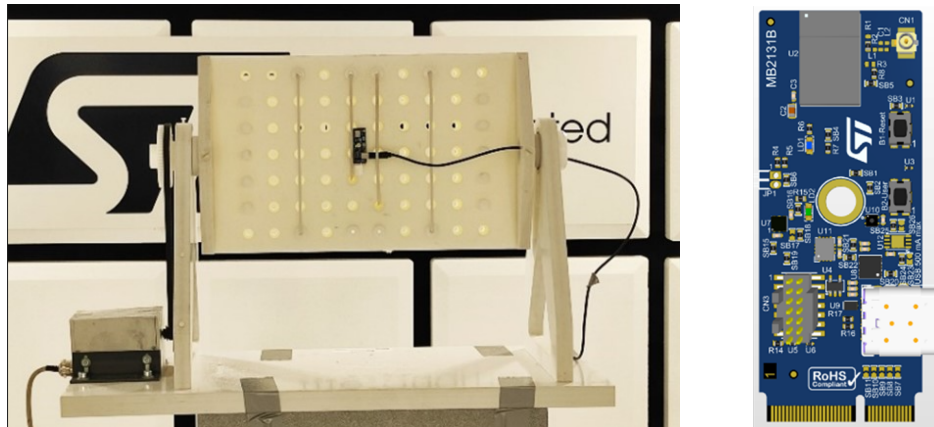
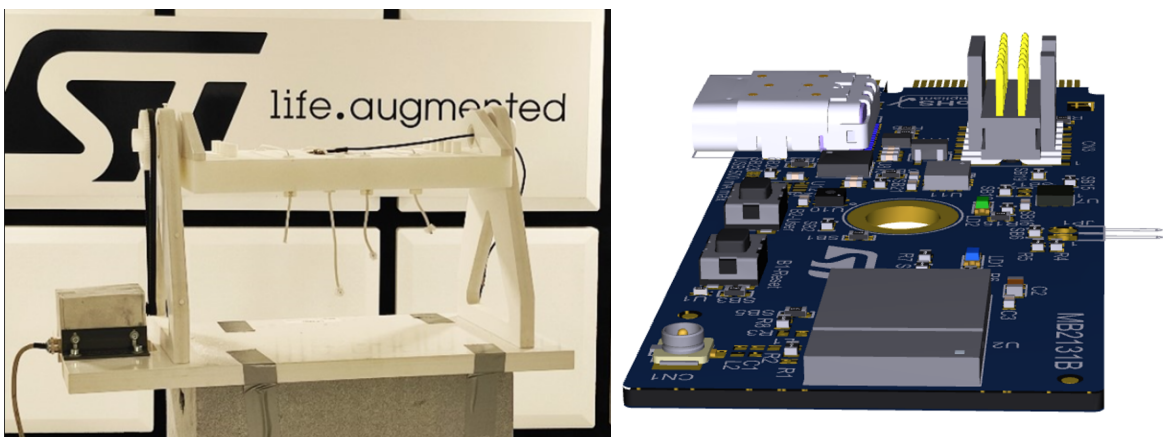


Figure 5. Z board position



3.2 Antenna polarization

The receiver antenna is fixed, and the board is turning from 0 to 359°.

Figure 6. Antenna polarization - horizontal

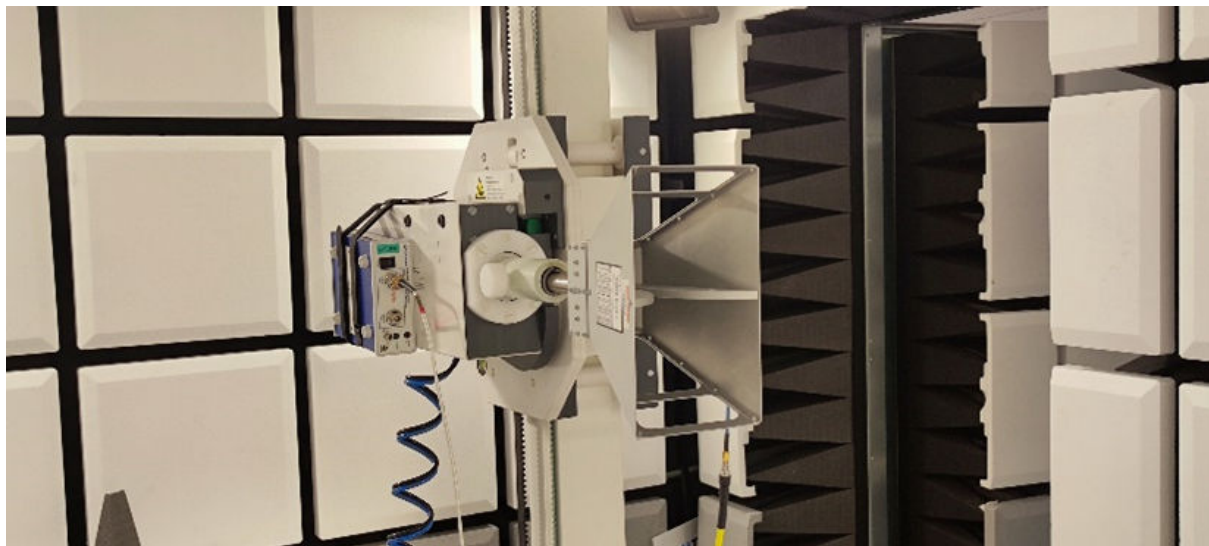
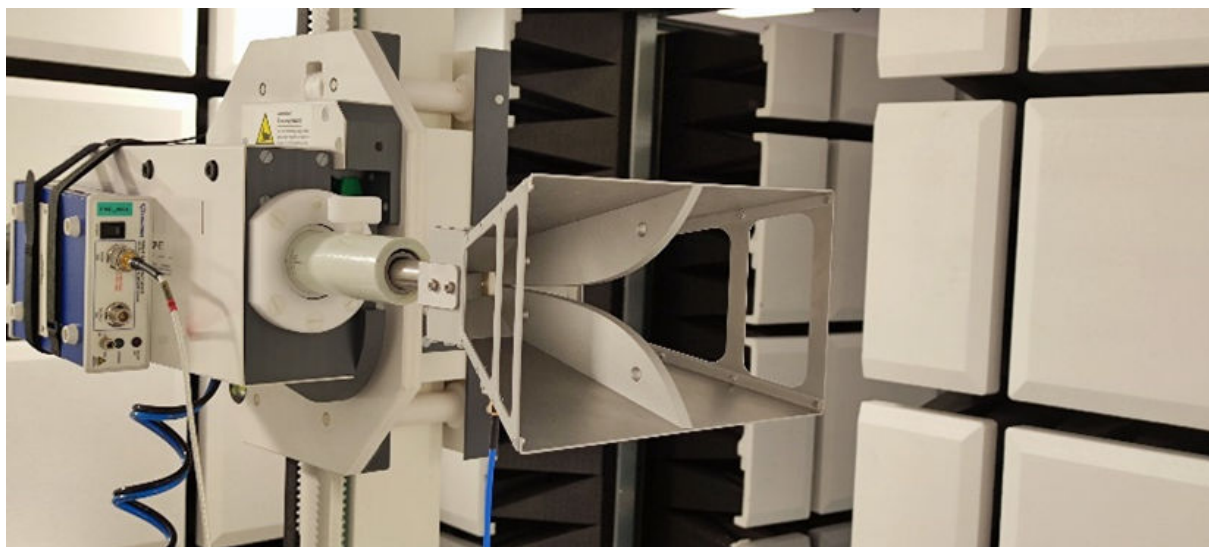


Figure 7. Antenna polarization - vertical



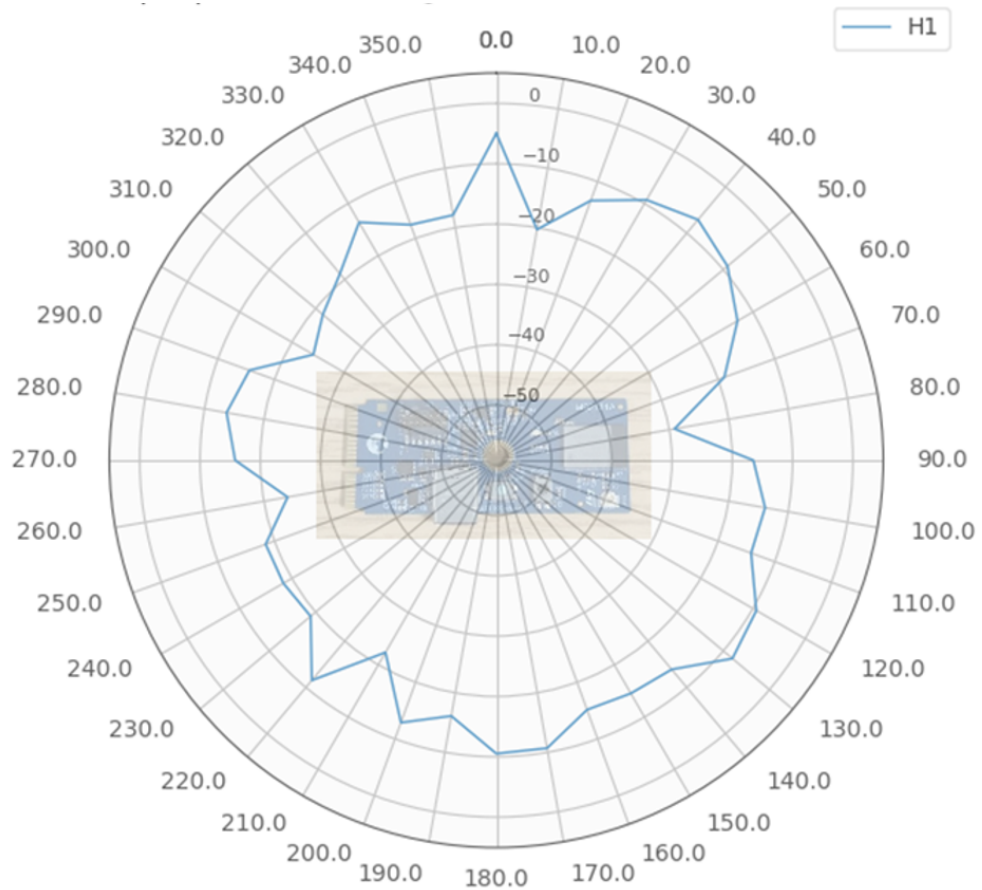
4 Test results

4.1 Radiation diagrams

The following radiation diagrams show the results for three different frequencies (low, medium, and high), three directions (X, Y and Z), and two polarizations (horizontal and vertical).

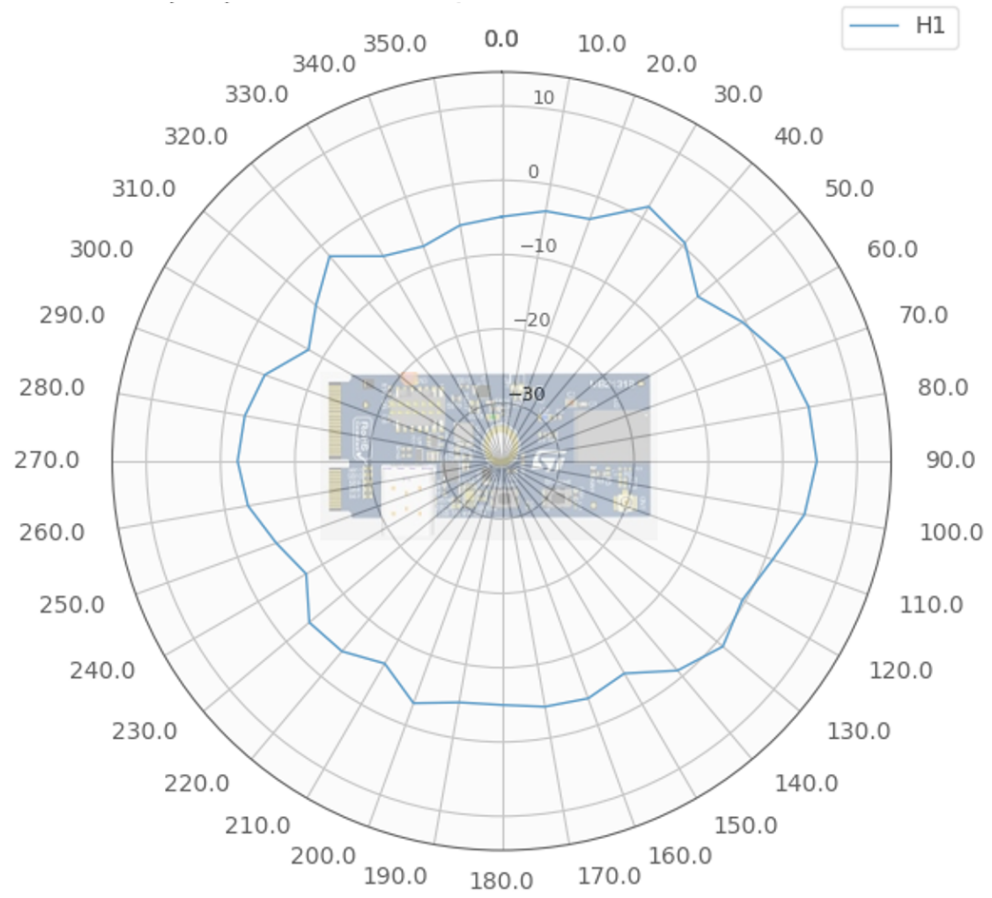
Output power radiated at 2.402 GHz

Figure 8. Output power radiated @ 2.402 GHz horizontal X (dBm)



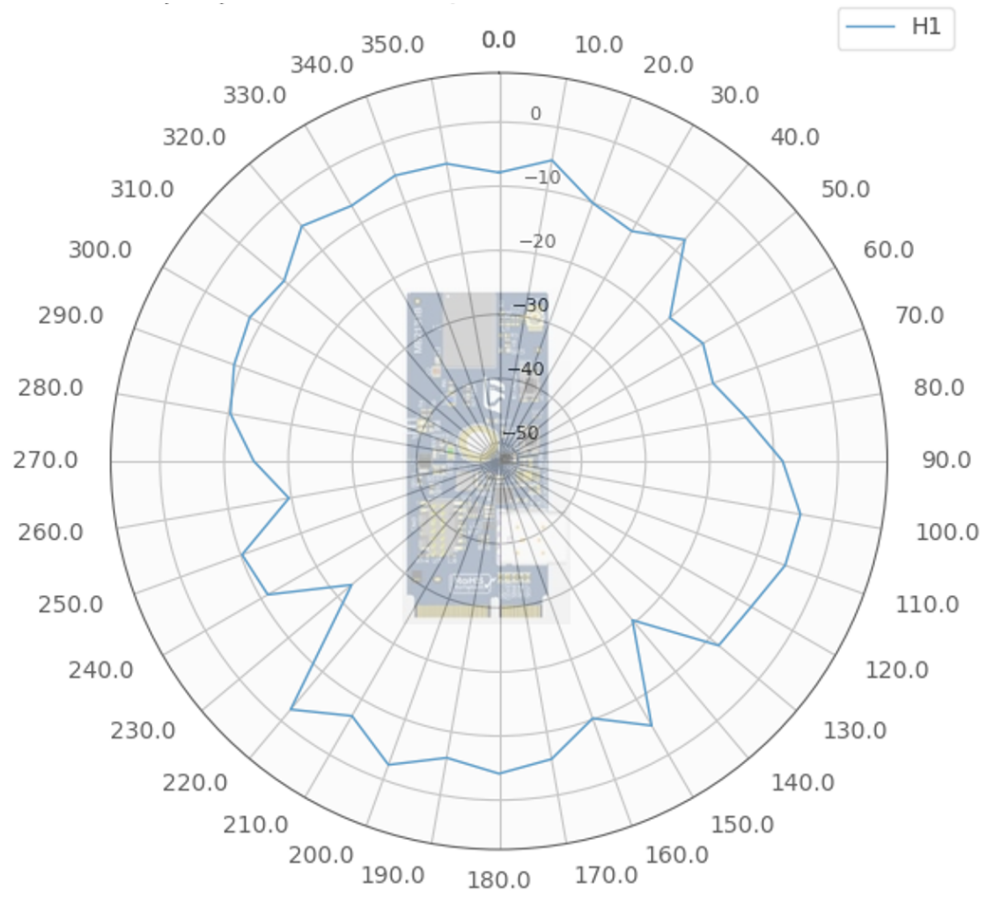
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Figure 9. Output power radiated @ 2.402 GHz vertical X (dBm)



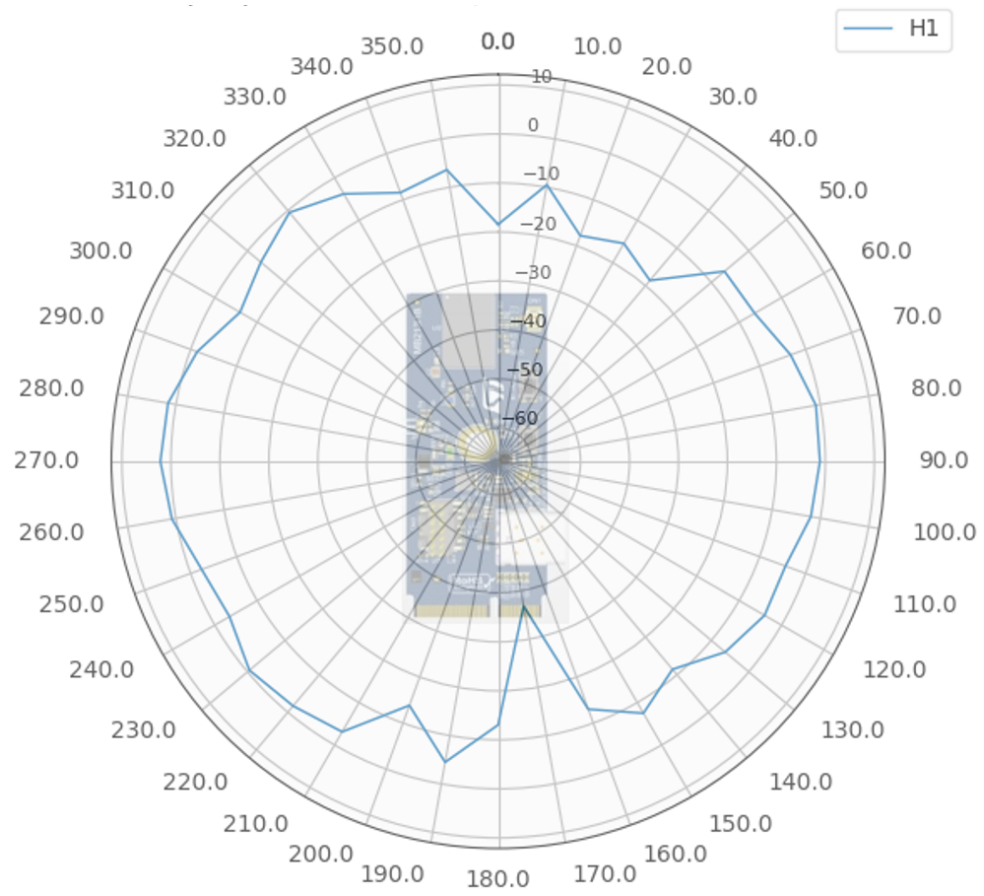
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Figure 10. Output power radiated @ 2.402 GHz horizontal Y (dBm)



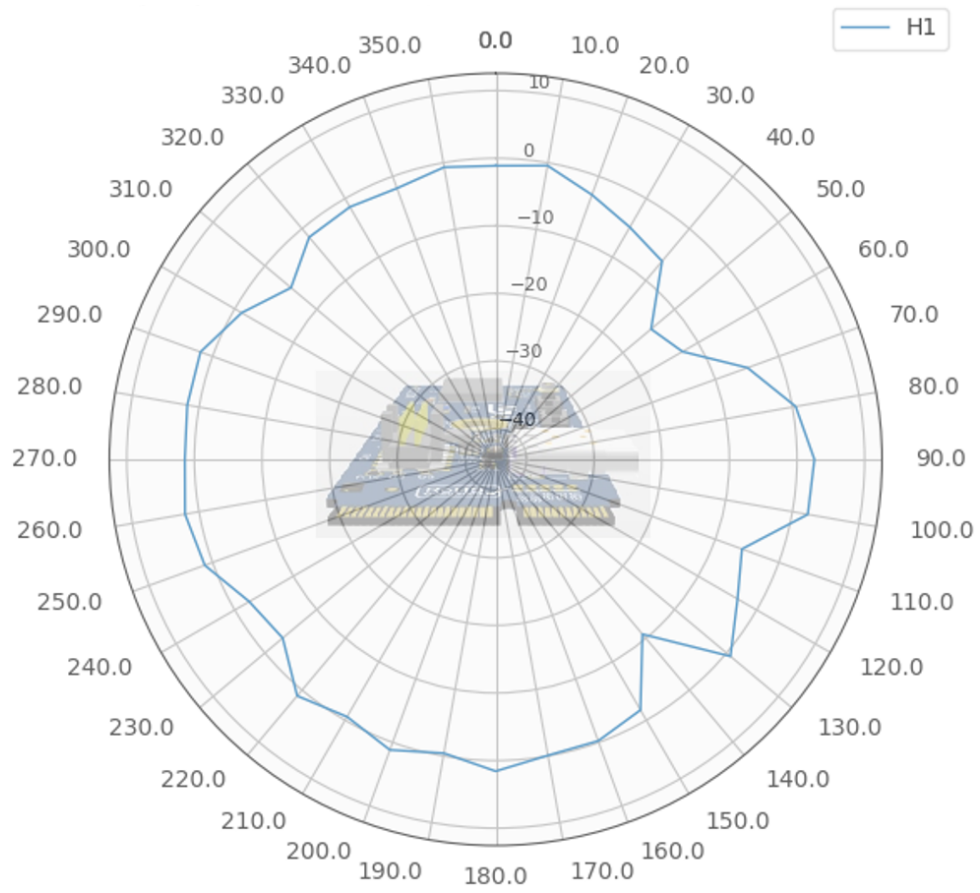
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Figure 11. Output power radiated @ 2.402 GHz vertical Y (dBm)



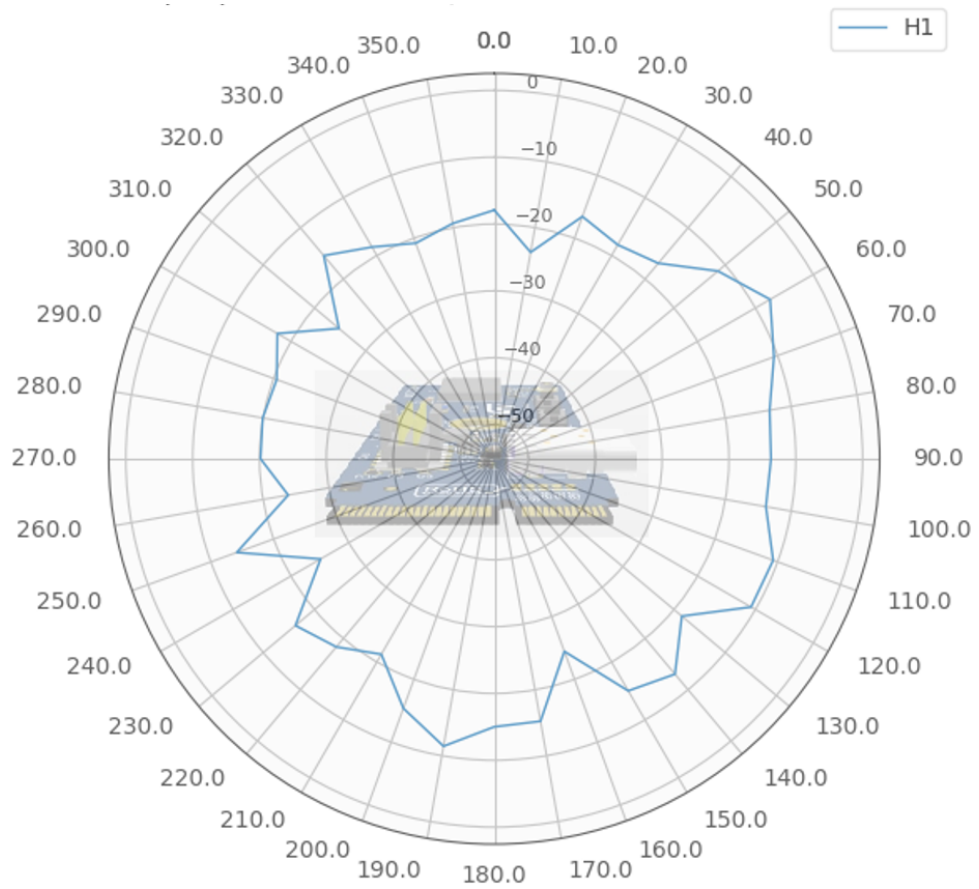
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Figure 12. Output power radiated @ 2.402 GHz horizontal Z (dBm)



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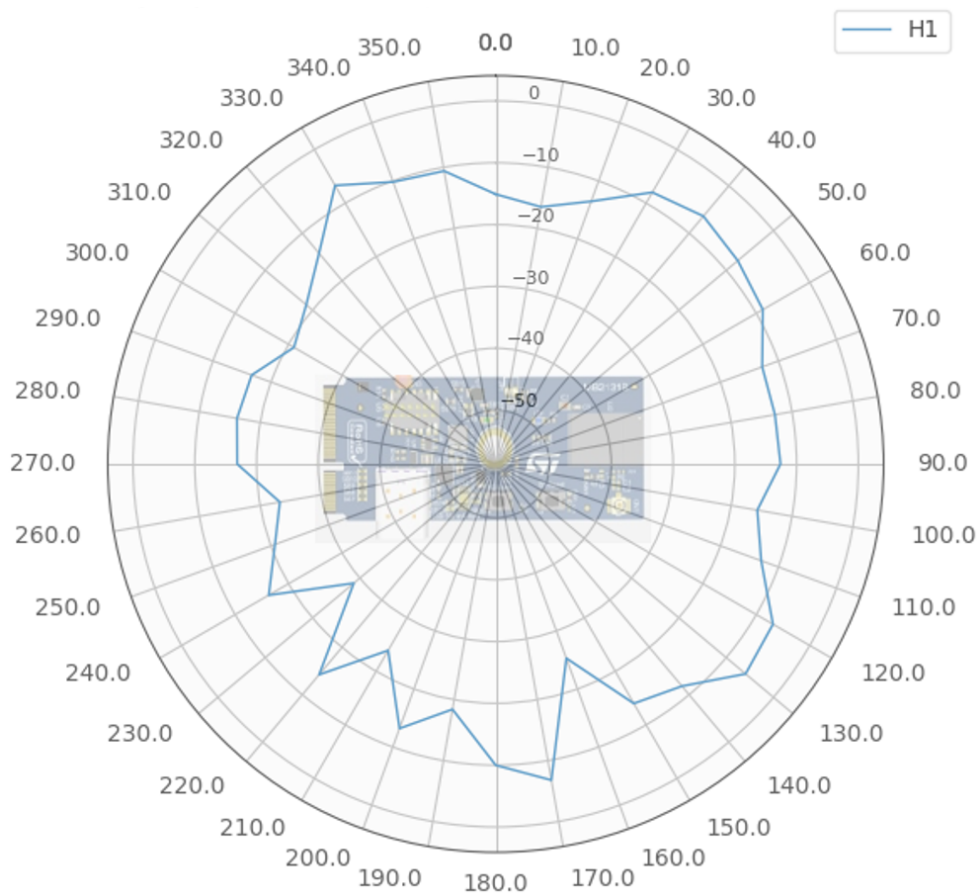
Figure 13. Output power radiated @ 2.402 GHz vertical Z (dBm)



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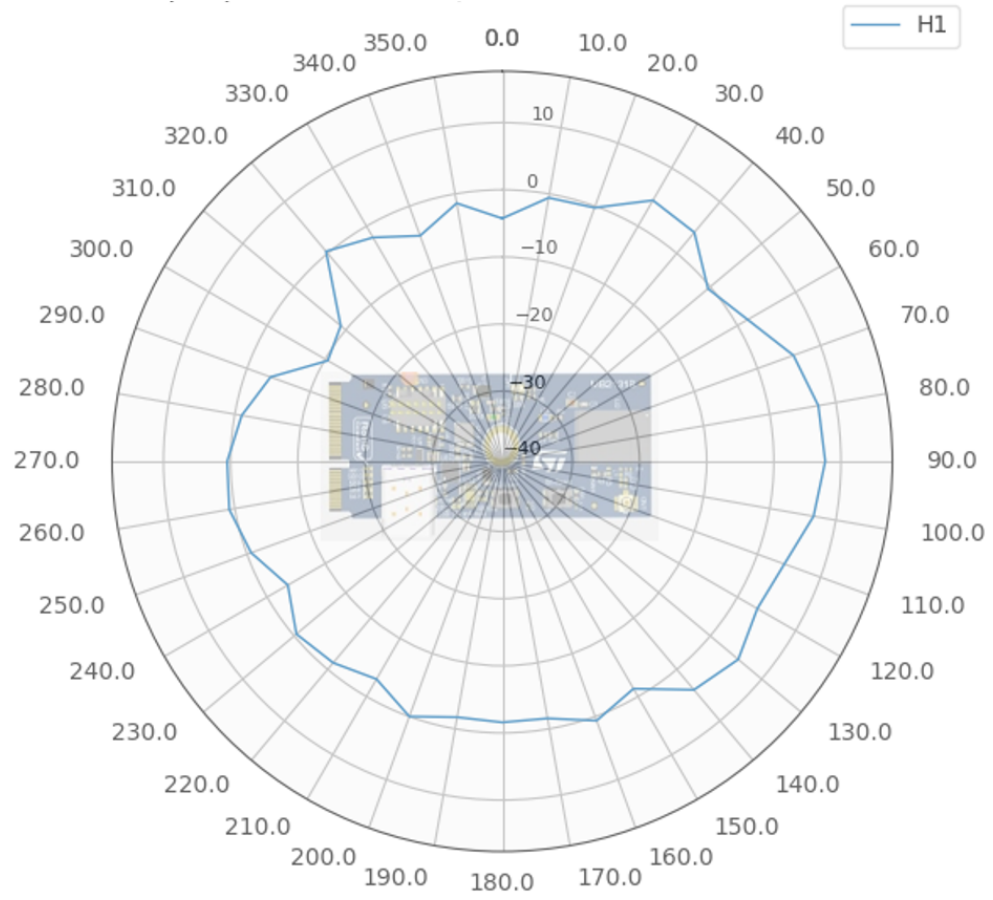
Output power radiated at 2.444 GHz

Figure 14. Output power radiated @ 2.444 GHz horizontal X (dBm)



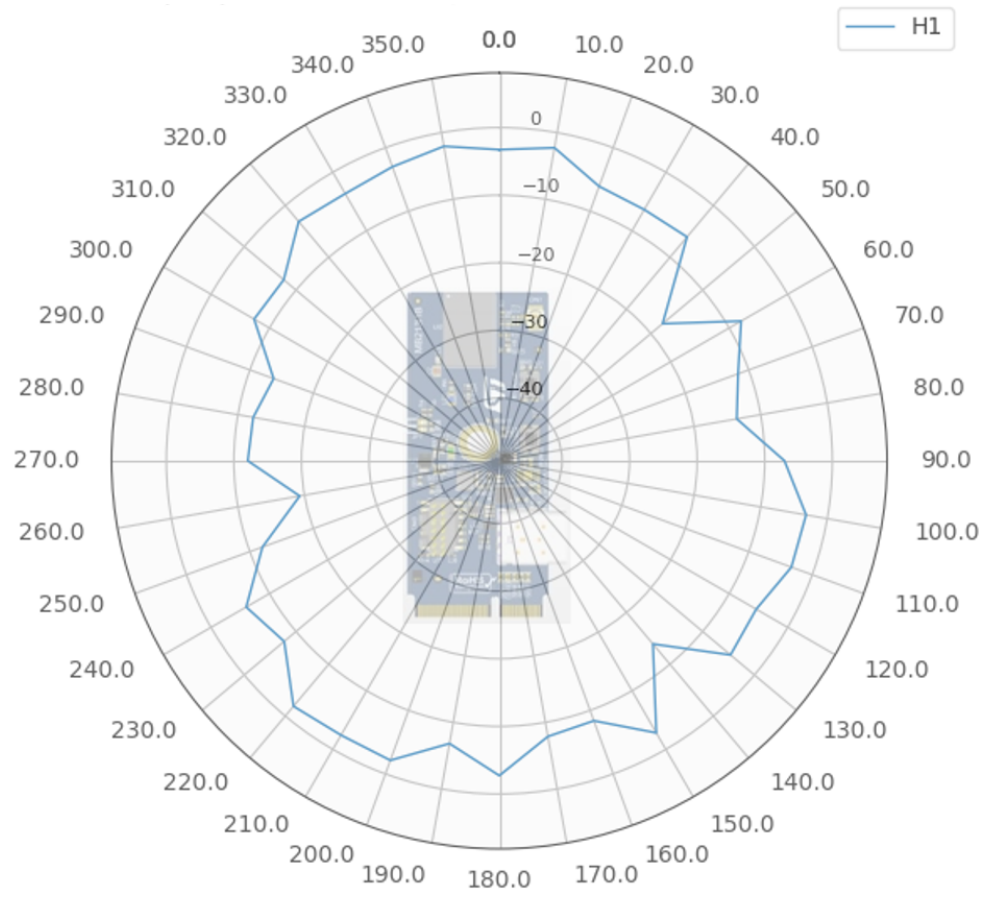
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Figure 15. Output power radiated @ 2.444 GHz vertical X (dBm)



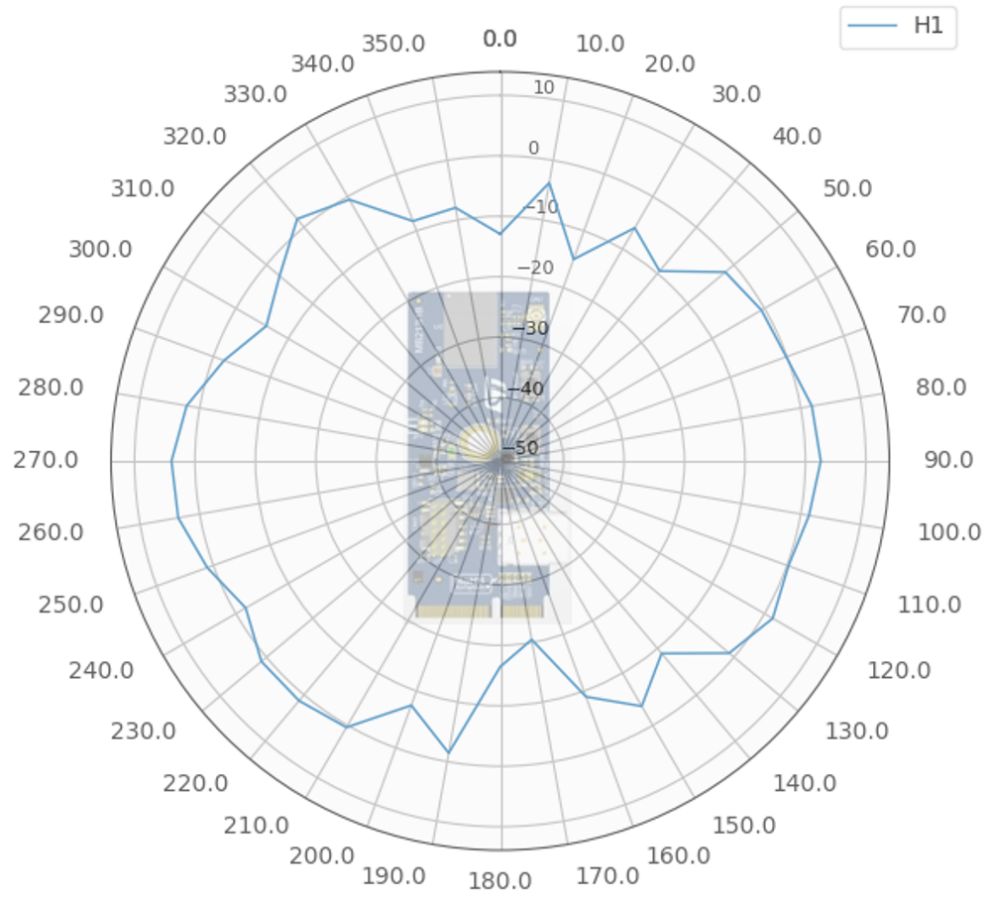
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Figure 16. Output power radiated @ 2.444 GHz horizontal Y (dBm)



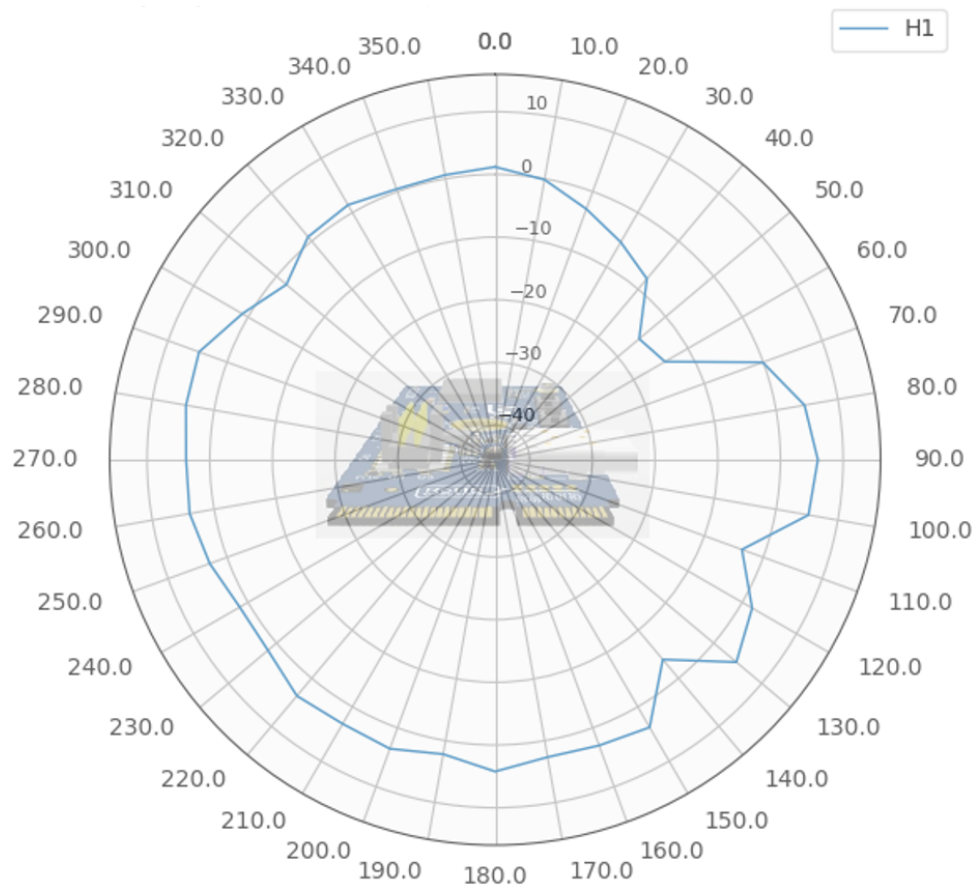
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Figure 17. Output power radiated @ 2.444 GHz vertical Y (dBm)



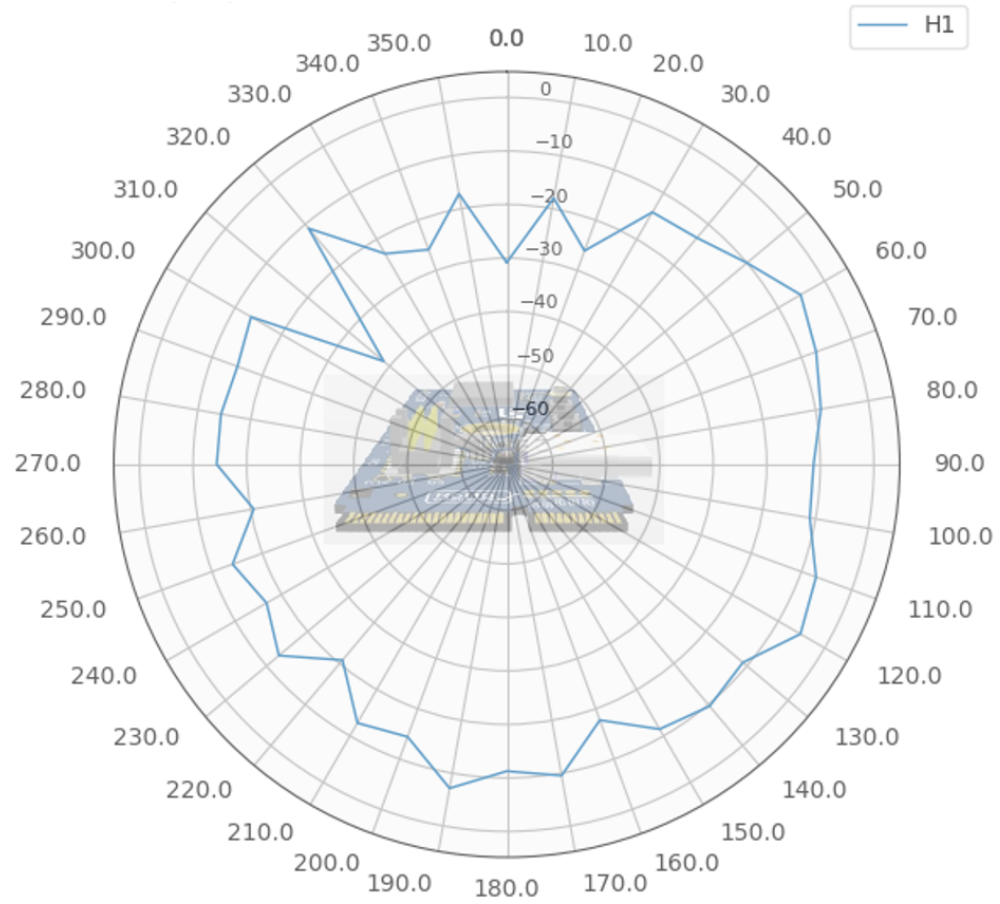
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Figure 18. Output power radiated @ 2.444 GHz horizontal Z (dBm)



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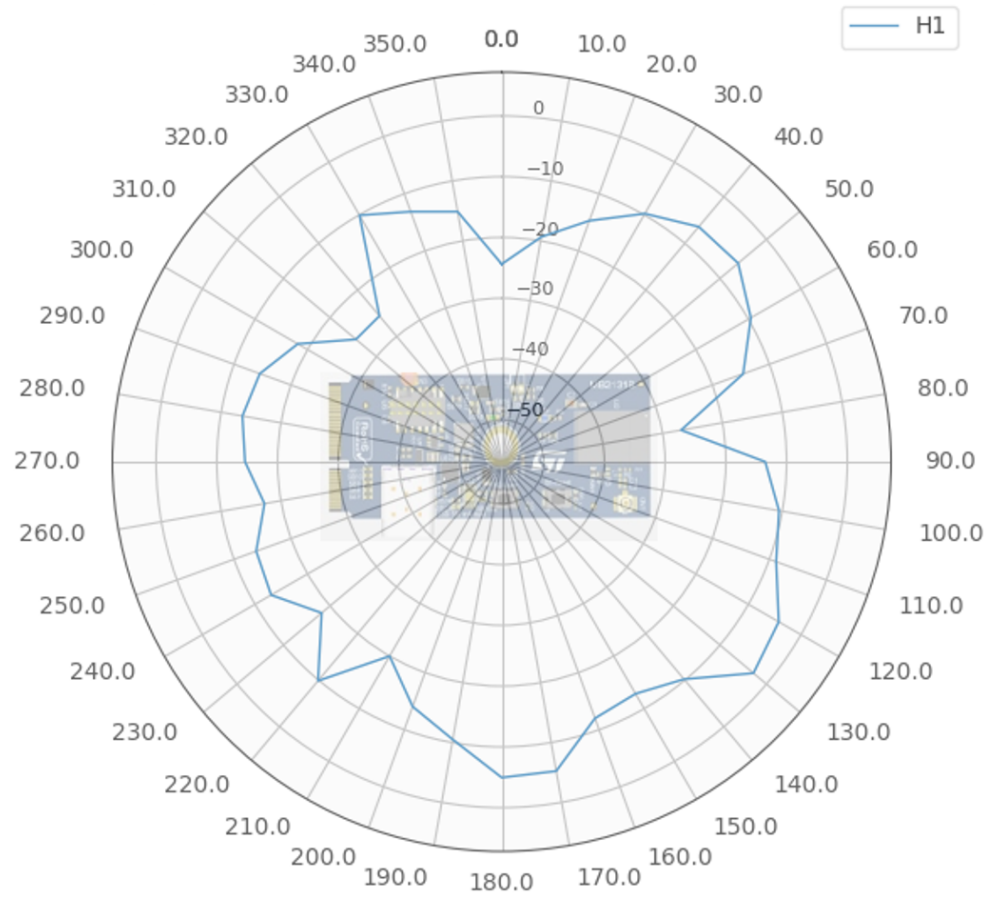
Figure 19. Output power radiated @ 2.444 GHz vertical Z (dBm)



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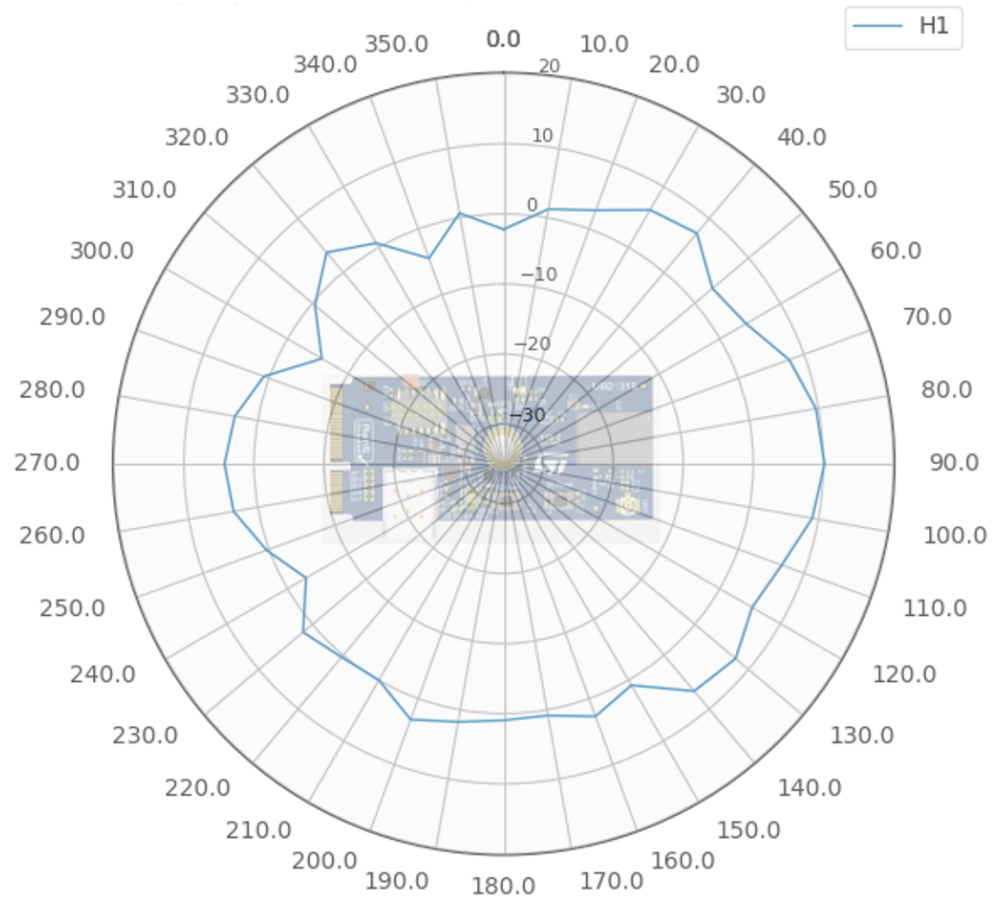
Output power radiated at 2.48 GHz

Figure 20. Output power radiated @ 2.48 GHz horizontal X (dBm)



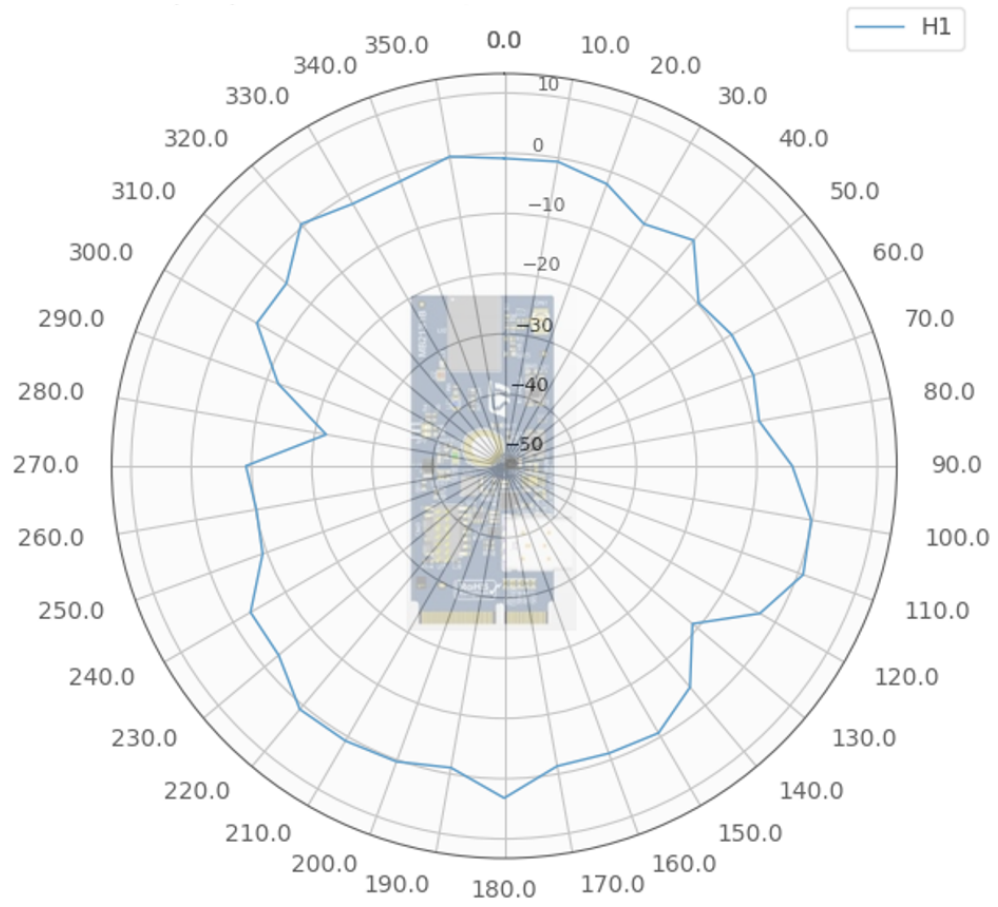
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Figure 21. Output power radiated @ 2.48 GHz vertical X (dBm)



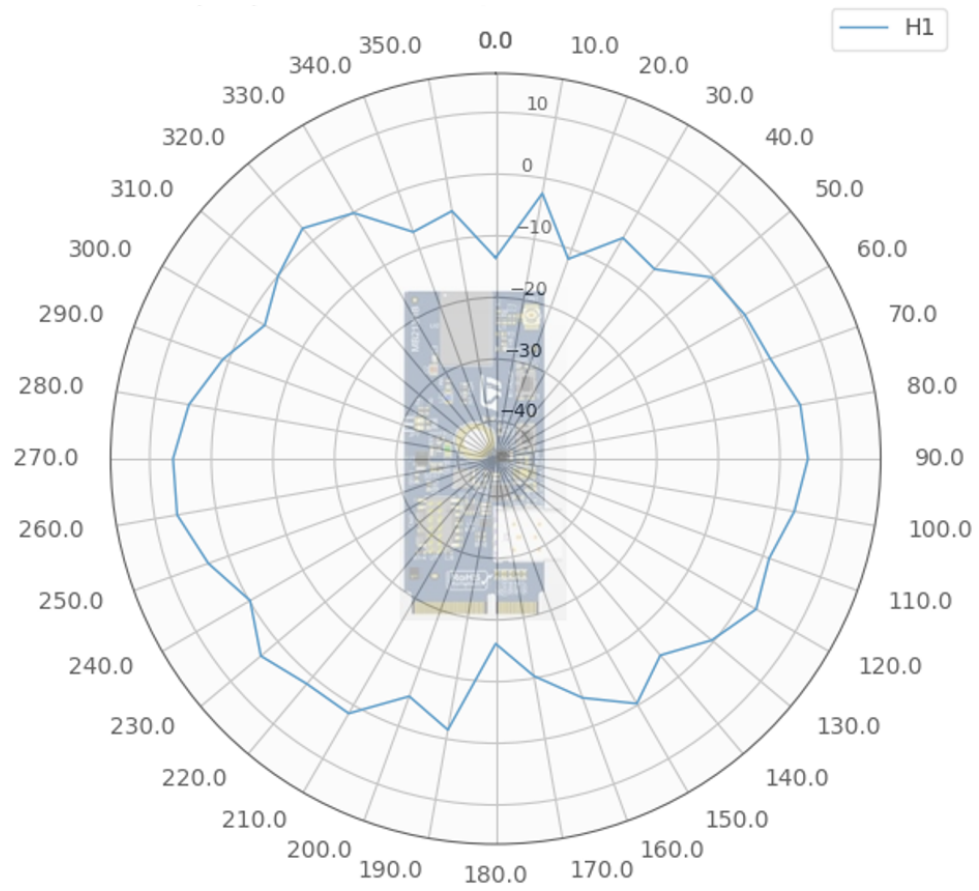
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Figure 22. Output power radiated @ 2.48 GHz horizontal Y (dBm)



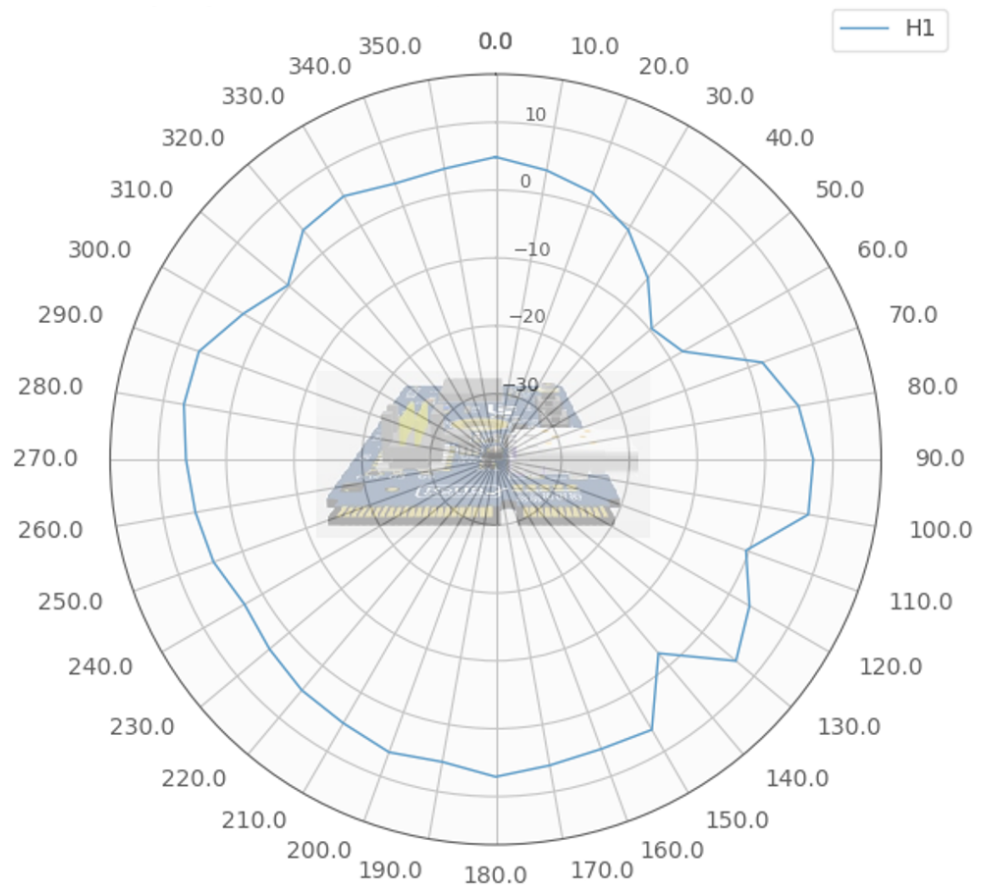
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Figure 23. Output power radiated @ 2.48 GHz vertical Y (dBm)



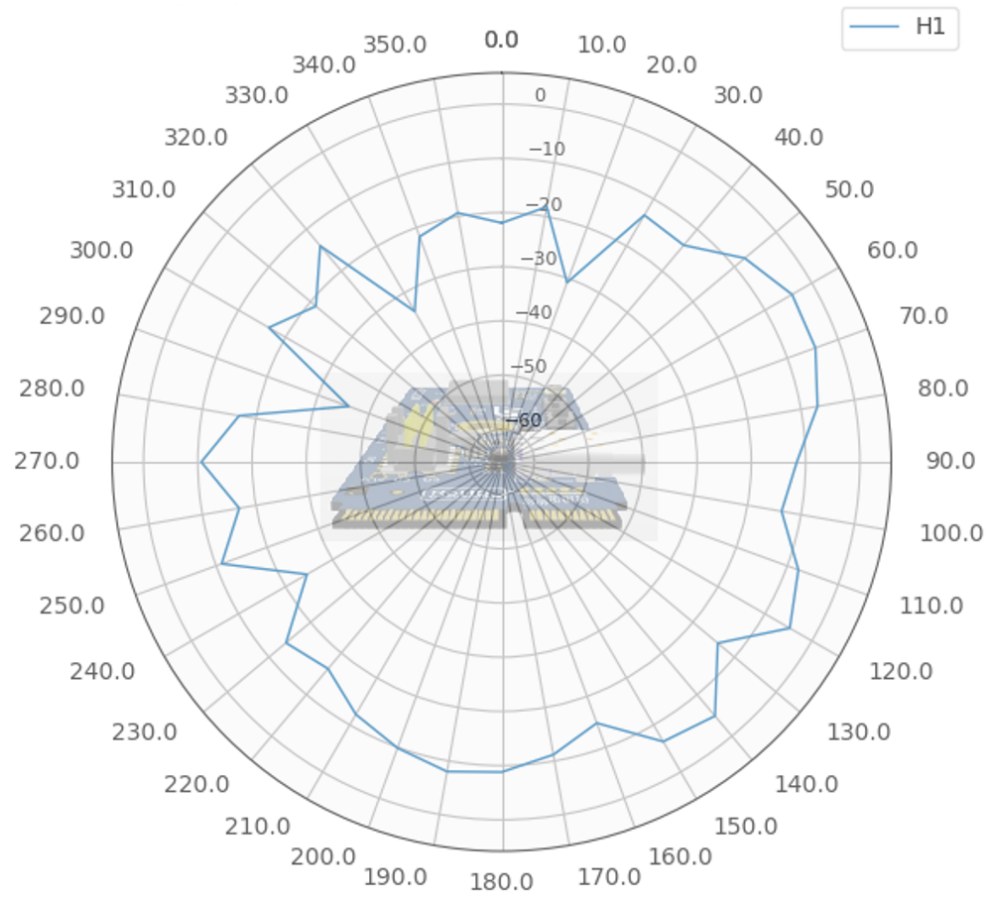
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Figure 24. Output power radiated @ 2.48 GHz horizontal Z (dBm)



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Figure 25. Output power radiated @ 2.48 GHz vertical Z (dBm)



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4.2 Summary of test results

The tables below summarize the results of the tests performed at different frequencies.

Table 3. Test results at 2402.0 MHz

Board position	Polarization	P min	P max	Angle P max (°)	P average
X	Horizontal	-29.1	-5.0	0	-15.4
X	Vertical	-7.8	4.6	90	-2.7
Y	Horizontal	-22.9	-2.3	220	-9.5
Y	Vertical	-36.8	2.2	270	-7.0
Z	Horizontal	-14.6	2.6	90	-1.9
Z	Vertical	-25.1	-7.4	60	-16.9

Table 4. Test results at 2444.0 MHz

Board position	Polarization	P min	P max	Angle P max (°)	P average
X	Horizontal	-28.7	-5.9	130	-14.3
X	Vertical	-10.4	7.7	90	0.1
Y	Horizontal	-19.3	-1.9	220	-7.2
Y	Vertical	-20.5	3.9	270	-3.5
Z	Horizontal	-15.5	6.0	90	0.6
Z	Vertical	-38.6	-5.2	60	-14.8

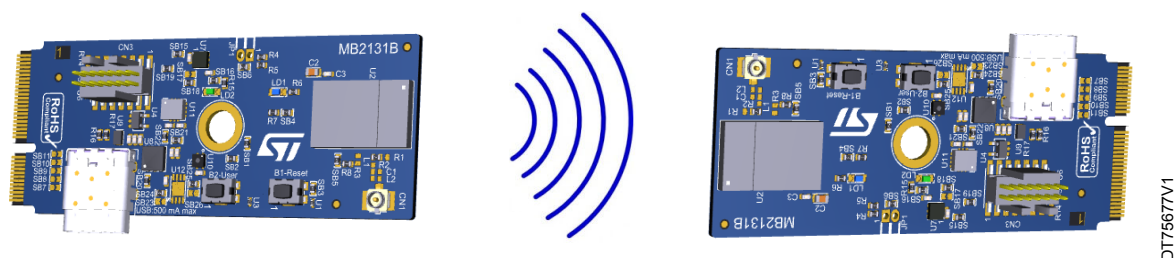
Table 5. Test results at 2480.0 MHz

Board position	Polarization	P min	P max	Angle P max (°)	P average
X	Horizontal	-26.9	-2.8	130	-13.4
X	Vertical	-5.7	10.2	90	2.8
Y	Horizontal	-21.9	3.2	180	-4.1
Y	Vertical	-16.1	6.4	260	-1.4
Z	Horizontal	-9.7	7.1	90	3.3
Z	Vertical	-36.0	-4.2	60	-14.5

5 Conclusion

The figure below shows the relative position of two boards for the best transmission quality.

Figure 26. Relative position of two boards for Tx and Rx



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Revision history

Table 6. Document revision history

Date	Version	Changes
10-Jan-2025	1	Initial release.

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